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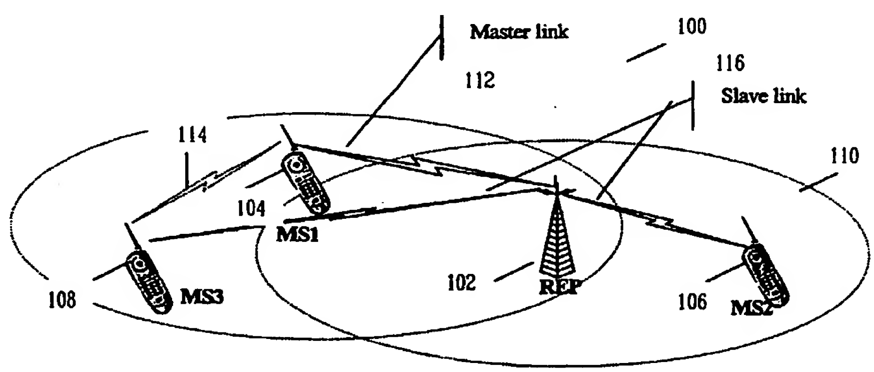
(54) Abstract Title
Setting up a direct mode call in a mobile communication system

(57) The communication system comprises a number of mobile terminals 104-108 which can communicate directly (direct mode) 114 or via a repeater 102. a first terminal 108 receives a call set-up request directly from a second terminal 104, which request includes an indication that the call is to be set up via the repeater. the terminal includes means for determining that the signal quality of the call set-up request received directly is better than when it is retransmitted via the repeater. In response to such a determination a direct mode call is set up with the second terminal. Otherwise the call may be set up via the repeater.



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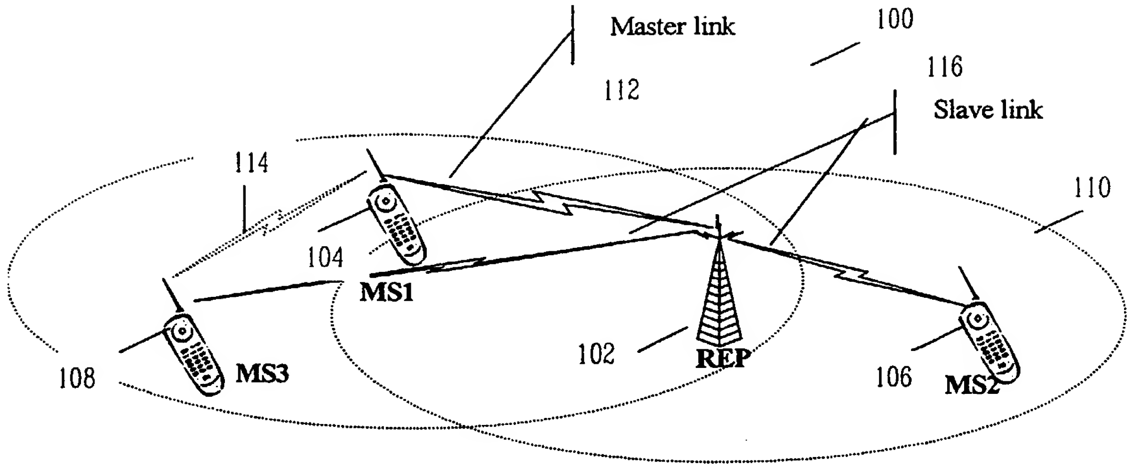


200 \

FIG. 2

202 \ 204 \ 206 \ 208 \ 210 \

222
Master link

	17				18				1				2				3			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
226 Master-rep	su	su	su	su	su	su	su										tc			
228 Rep-master																				

224
Slave link

	17				18				1				2					
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2
230 Rep-slave					su'	su'	su'	su'	su'	su'	su'	su'					tc'	
232 Slave-rep																		

5 214 / 216 / 218 / 220 /

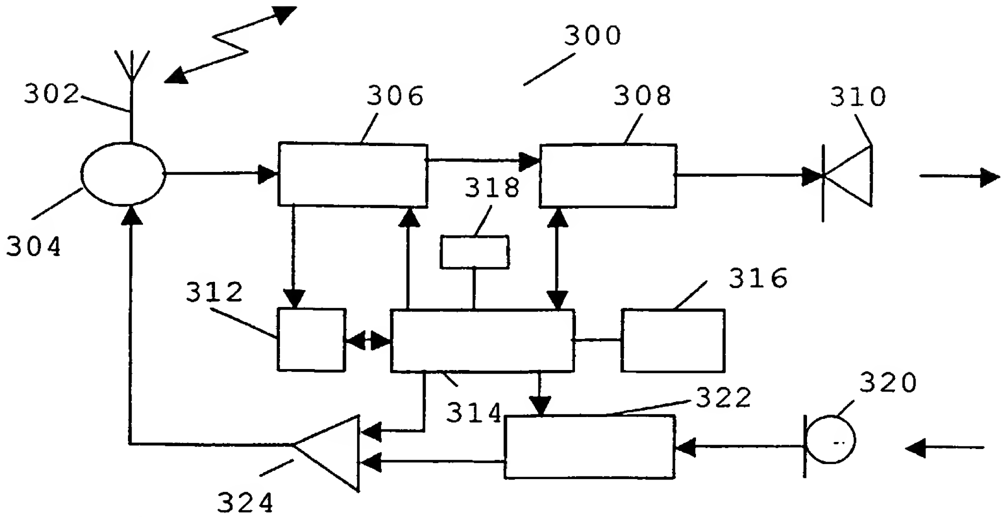
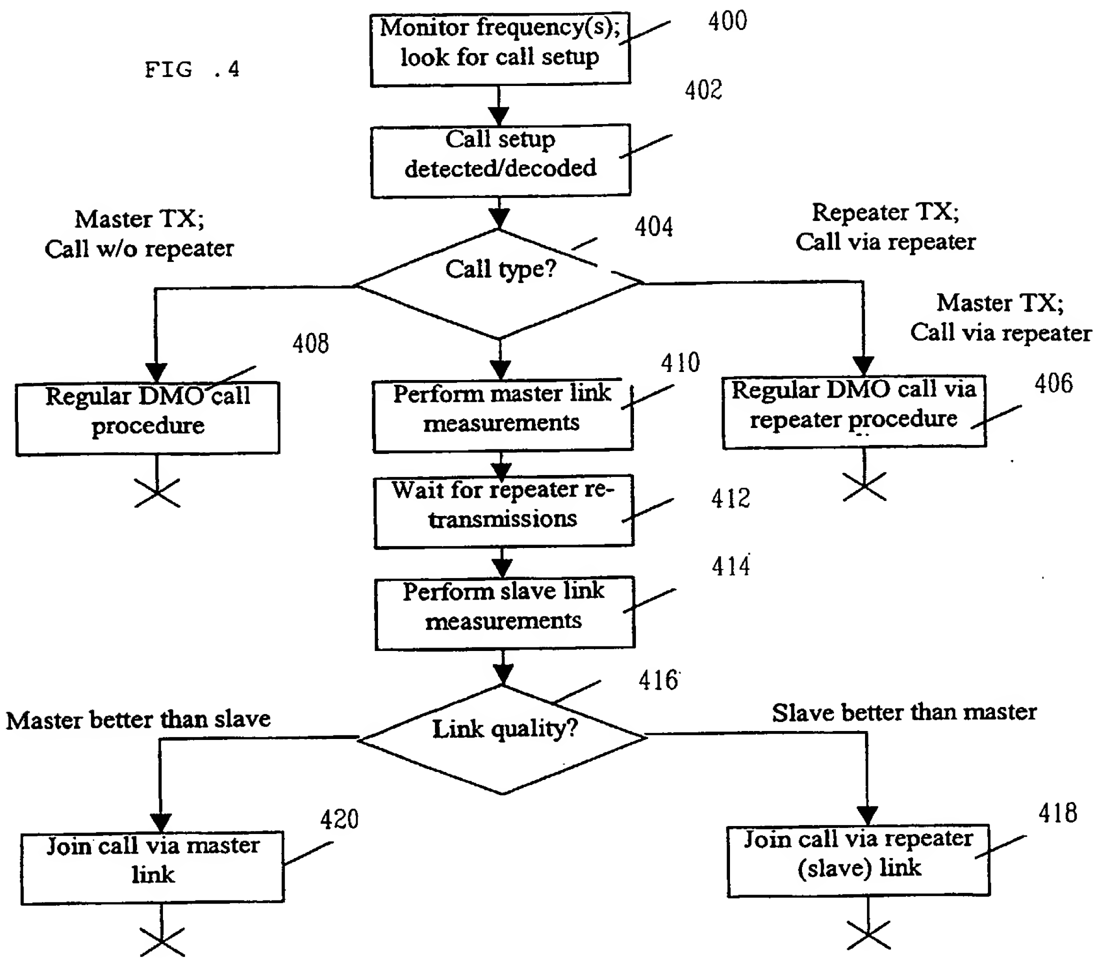


FIG. 3

FIG .4


Monitor frequency(s); look for call setup
400
Call setup detected/decoded
402
Call type?
404
Master TX; Call w/o repeater
Repeater TX; Call via repeater
Master TX; Call via repeater
Regular DMO call procedure
408
Perform master link measurements
410
Regular DMO call via repeater procedure
406
Wait for repeater re-transmissions
412
Perform slave link measurements
414
Link quality?
416
Master better than slave
Slave better than master
Join call via master link
420
Join call via repeater (slave) link
418

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WIRELESS COMMUNICATION SYSTEM, WIRELESS COMMUNICATION UNIT AND METHOD OF CALL SET-UP

Field of the Invention

This invention relates to the selection of a communication resource in a communication system. The invention is applicable to, but not limited to, a subscriber unit selecting a direct communication radio link between itself and a second subscriber unit, instead of a communication link passing through a radio repeater station.

Background of the Invention

Wireless communication systems are distinguished over fixed communication systems, such as the public switched telephone networks (PSTN), principally in that subscriber units move between communication service areas and providers and in doing so encounter varying radio propagation environments. Therefore the quality of a communication link to/from a subscriber unit varies as the subscriber unit changes location.

The subscriber units are typically either vehicular-mounted 'mobile' or 'hand-portable' radio or cellular units. Henceforth, the term mobile station (MS) will be used for all such subscriber units.

Wireless communication systems, for example cellular telephony or private mobile radio communication systems, typically provide for radio telecommunication links to be arranged between a plurality of subscriber units.

In a wireless communication system, there are typically two methods of communicating to a MS. A first method is a direct communication between two MSs. A second method uses an intermediary station to forward the communication. The intermediary station may be a base transceiver station (BTS) connected to the communication system infrastructure. A BTS is generally considered an "intelligent" terminal, as it has the processing and control capability to influence a substantial amount of the communication traffic passing through it.

A further intermediary station is a radio Repeater station, which performs a minimal amount of processing in receiving a communication from a first MS and re-transmitting the received communication to at least one second MS. As a Repeater station has little control over the communication passing through it, it is often termed a "dummy" terminal.

The communication link from a BTS or a Repeater to a MS is generally referred to as a down-link communication channel. Conversely, the communication link from a MS to a BTS or a Repeater is generally referred to as an up-link communication channel.

Multiple access techniques permit simultaneous communication links to be set-up to/from several MS over a plurality of communications channels. Some channels are used for carrying traffic whilst other channels (which may be logical or dedicated channels) are used for transferring control information. Examples of multiple access techniques include: frequency division multiple access (FDMA), time division multiplexing/ multiple access (TDM, TDMA) and code division multiple access (CDMA).

In a wireless private mobile radio (PMR) communication system, it is known that a MS may operate outside of a dedicated network coverage area by communicating in a direct communication link with at least one other MS. Such a communication mode is generally referred to as Direct Mode Operation (DMO). This term is in contrast to Trunked mode operation (TMO) that enables the MS to work within a network coverage, with communications controlled and facilitated by a switching and management infrastructure (SwMI). Hence, when a MS operates in DMO, there is no system controller and therefore no centralised timing synchronisation or power control to help minimise interference.

DMO is similar to the back-to-back operation of conventional half-duplex radio schemes used by many existing private mobile radio (PMR) systems such as that of the emergency services. DMO communications are limited in range due to limitations placed on the MS, such as maximum transmit power or channel conditions.

When operating in DMO, MSs communicate over dedicated frequencies. A MS operating in DMO may manually select a dedicated frequency or the MS may scan the available dedicated frequencies to find an available frequency based on signal strength measurements. In some direct mode environments there may be a pool of communication channels available.

The selection of a particular frequency by a MS is generally dependent upon whether the measured signal strength exceeds a fixed, acceptable-communication threshold. Both methods of selecting and scanning frequencies are inefficient when there are a large numbers of users in a DMO system, due to the unstructured nature and consequential high level of interference associated with such direct mode communications.

Furthermore, the received signal level varies sporadically due to the changing propagation conditions. In addition, interference is dependent upon the number of users and the number of users varies from time to time on a system.

In radio communication systems operating without a fixed network control, such as DMO, communication repeaters have often been used to extend the communication range of MS to MS communications. For instance, a first MS may transmit to a Repeater for re-transmission, after minimal decoding and error correction processing, to a second MS.

Such a communication is particularly advantageous if the second MS would have been out of transmitting range of the first MS without the use of the Repeater. A direct mode Repeater thus provides a service for direct mode radios wishing to communicate over an enlarged direct mode coverage area. Direct mode repeaters may operate using either a single frequency or two frequencies.

There is no known mechanism in place for MSs operating in DMO to optimise the use of the direct mode resources. As a consequence, there are no signalling schemes for a direct mode repeater to form any type of a broadcast signal during periods of channel inactivity and/or during periods of communications. Lack of available signalling information will likely result in some calls being jammed or never even set up. In a public safety market, such an unreliable communication link is unacceptable.

A known technique for operation via a DMO Repeater has been defined by the European Telecommunication Standards Institute (ETSI) in the TErrestrial Trunked RAdio (TETRA) standard in ETS-300-396-4.

According to the TETRA DMO standard, all MSs working through a DMO Repeater station will monitor down-link transmissions from the Repeater in order to receive calls via the Repeater. The down-link transmission is basically a repeated and delayed version of the corresponding up-link transmission.

According to the TETRA DMO standard a calling MS is instructed, either by pre-programmed information or by detection of the Repeater's presence signal, to address the Repeater when attempting to set-up a call and subsequently transmit to a Talk Group or other individual MS. Called MSs know, either by pre-programming or by detection of the Repeater's presence signal, to monitor only the downlink repeater link searching for their own individual or group address. Once they have received a re-transmission signal from the Repeater, specifying their individual or group address, they can decide whether or not to join the individual or group-call.

However, the inventors of the present invention have recognised that such a call set-up mechanism is inefficient in certain operational scenarios. First, let us assume that a first MS is attempting to set up a group-call, via a Repeater, with a second and third MS. The second MS is within range of the Repeater, but the third MS is determined to be outside the coverage range of the Repeater but within coverage range of a direct transmission from the first MS.

Hence, although the third MS can receive a communication direct from the first MS, the third MS will not be included in the group-call, as it will not receive any re-transmitted signal from the Repeater.

Another scenario might be that at least some members of the talk group may be able to receive both the calling MS and the Repeater's re-transmitted signal, but a direct

signal from the calling MS may be received at a much higher quality than the re-transmitted signal from the Repeater. According to the existing TETRA standard such MSs are forced to receive calls at the lower quality via the Repeater.

In summary, standard DMO communication, via a Repeater, imposes potentially unnecessary limitations on the quality of a communication link in certain operational scenarios. The stipulation of a DMO communication to operate via a Repeater, at all times, will often lead to sub-optimal call quality.

Thus there currently exists a need to provide a communication system, a communication unit and method of setting up a call where the aforementioned disadvantages may at least be alleviated.

Statement of Invention

In accordance with the present invention there is provided a communication system as claimed in claim 1.

In accordance with the present invention there is provided a communication unit as claimed in claim 6.

In accordance with the present invention there is provided a method of setting up a call as claimed in claim 11.

Brief Description of the Drawings

Exemplary embodiments of the present invention will now be described, with reference to the accompanying drawings, in which:

FIG. 1 shows a block diagram of a direct mode radio communication system adapted to support the various inventive concepts of a preferred embodiment of the present invention;

FIG. 2 shows a timing diagram illustrating a known timing process that can be implemented in the direct mode communication system of FIG. 1 to facilitate the inventive concepts of a preferred embodiment of the invention;

FIG. 3 shows a block diagram of a subscriber unit adapted to support the inventive concepts of the preferred embodiments of the present invention; and

FIG. 4 shows a flowchart of the decision making process for performing a call set-up in accordance with a preferred embodiment of the invention.

Description of Preferred Embodiments

In accordance with a preferred embodiment of the invention, MSs operating in DMO use both up-link and

down-link (via a Repeater) aspects of a direct mode call set-up transmission, in order to assess whether they wish to join a call directly or via the Repeater.

In particular, the inventors of the present invention have recognised the opportunity, and associated benefits thereby provided, to monitor up-link as well as down-link transmissions in a call set-up procedure in a DMO communication system.

Turning first to FIG. 1, a typical DMO communication scenario is shown. The DMO communication system 100 includes a Repeater 102 facilitating communications between a number of MSs (104, 106, 108). Repeater 102 effectively provides a communication coverage range as shown by area 110. In a true DMO communication system, many MSs will be able to communicate at any instant in time, with three MSs are shown in FIG. 1 for clarity purposes only.

In operation, MS-1 wishes to set up a group-call with MS-2 106 and MS-3 108. As can be seen, MS-2 106 is within the communication coverage range of Repeater 102, whilst MS-3 108 is not. However, MS-3 108 is within direct communication coverage range of MS-1 104.

In the preferred embodiment of the invention, for example with regard to the TETRA standard, MS-1 104 transmits a group-call set-up request 112 to Repeater 102 on an "up-link (master-link) timeslot". MS-3 108 receives this group-call request by a direct communication link 114.

The Repeater re-transmits the group-call set-up request to another MS, or group of MSs, on a "down-link (slave-link) timeslot" 116, for example to MS-2 106 and MS-3 108. As MS-3 108 is out of communication range of Repeater 102, MS-3 108 fails to receive the re-transmission of the group-call set-up request 116.

At the same time, MS-2 106 is out of direct communication range with MS-1 104, and only receives the re-transmission of the group-call set-up request 116, from the Repeater 102. The Repeater 102 specified within the TETRA standard is regenerative, i.e. it decodes and re-encodes received speech and signaling bursts which it receives (one slot's worth each time), to improve the overall link performance.

In accordance with the preferred embodiment of the invention, MS-3 108 has been adapted to decode call set-up messages received directly from MS-1 104, in addition to any call set-up message re-transmitted from Repeater 102. Both MS-2 106 and MS-3 108 will recognise that the call is to be established via Repeater 102 due to the inclusion of a Repeater address in the call set-up request transmitted by MS-1 104.

MS-2 106 and MS-3 108 will independently perform link measurements of the direct communication link 114 with MS-1 104 (if it exists) using the group-call set-up transmission request from MS-1 104 on the master-link 112. Preferably, such link quality measurements may

include any of the following: received signal strength indication (RSSI), bit-error-rate (BER), message-error-rate (MER), carrier to interference (C/I), or any other known quality indicia.

In addition, whilst the Repeater 102 re-transmits the group-call set-up message 116, as initially transmitted by MS-1 104, to both MS-2 106 and MS-3 108, MS-2 106 and MS-3 108 will perform the same link measurement on the Repeater's re-transmission call request signal 116 (if the signal can be successfully received).

Based on the link measurements of both the direct group-call set-up request transmission of master MS-1 104 and the Repeater's 102 re-transmitted group-call set-up request signal, MS-2 106 and MS-3 108 will independently decide whether to join the group call by receiving traffic communication direct from MS-1 104, or via the Repeater 102.

If a call set-up request transmission from either the master MS-1 104 or the Repeater 102 cannot be successfully received, the decision becomes trivial, as in the present case. In such a situation, MS-2 106 will join the group-call via the Repeater 102 and MS-3 108 will be able to join the group-call, by receiving and processing direct communication from MS-1 104.

However, if both the master-link 114 and the slave-link 116 can be successfully received and assessed, the decision is not trivial. In this case, MS-2 106 and/or

MS-3 108 would make a determination on whether to join the group-call directly with MS-1 104 or via the Repeater 102.

Generally, the decision would be to join the call via Repeater 102, so that any replies to MS-1 104 can also be heard and received by other MS. When the slave MS, for example MS-2 106, replies to the calling MS, the slave MS will always respond through the Repeater 102.

If the call request by MS-1 104 is for a broadcast communication, MS-2 106 and/or MS-3 108 would not need to make, or hear, any replies to the broadcast transmission from MS-1 104. In this case, the selection of the communication link could be based purely on the individual link's signal quality measurement.

It is within the contemplation of the invention that the inventive concepts described herein are equally applicable to group (point-to-multipoint) call set-up requests or individual (point-to-point) call set-up requests.

A known method of setting up a call in a DM channel is illustrated in FIG. 2. In FIG. 2, a MS (say, MS-1 104 of FIG. 1) initiates a call and establishes the channel synchronization by transmitting a sequence of call set-up messages to a Repeater (say, Repeater 102 of FIG. 1). On setting up a call the MS automatically assumes the role as "master", with the communication link to the Repeater being the master-link.

The call set-up arrangement is described with reference to the TETRA timing structure, which uses a TDMA access protocol 200. The timing structure is arranged in super-frames, with each super-frame comprising eighteen (rolling) time-frames. Time-frames seventeen to three 202-210 are shown with each divided into four time-slots 214-220, shown in relation to different time-frames for clarity purposes only.

The two-way communication link is divided into two parts:

(i) an up-link (master-link) 222 where the MS transmits in "master-Rep" time-slots 226 to the Repeater and receives messages in "Rep-master" time-slots 228 from the Repeater; and

(ii) a down-link (slave-link) 224 where the Repeater relays transmitted information from the transmitting MS in "Rep-slave" time-slots 230, to at least one other MS and is able to receive responses from the at least one other MS in "slave-Rep" time-slots 232.

In the example shown in FIG. 2, seven synchronization bursts ("su") are sent in master-Rep time-slots 226 in time-frame seventeen 202 and time-frame eighteen 204 of the master link 222. The synchronization bursts are received by the Repeater and re-transmitted ("su'") in Rep-slave time-slots 230 by the repeater on the slave-link. Note that due to propagation delays, the re-transmitted synchronization bursts "su'" are delayed by one time-frame compared to the initially transmitted synchronization bursts "su".

In this example, synchronisation bursts are transmitted in two frames giving up to a total of eight bursts, although the receiver needs only to receive just one of these bursts.

The master MS may then transmit traffic ("tc") information in the next available time-frame, which in this example is the first time-slot of the third time-frame 210 of the master link.

It is proposed that a receiving MS(s) will decode the "su" call setup messages received directly from MS-1, namely at least one of the seven synchronisation bursts in the "master-Rep" 226 series of time-slots. Receiving MS(s) will recognise that the call is to be established via Repeater due to the inclusion of the Repeater address in the call setup message.

Receiving MS(s) will independently perform link measurements between itself and the calling (master) MS using the "su" call setup transmission of the (master) MS.

Receiving MS(s) will tune to the "Rep-slave" 230 series of time slots on the slave-link channel 224 and also receive at least one "su'" call set-up request re-transmitted from the Repeater.

Based on the link measurements of both the master MS's direct "su" call set-up request and the Repeater's re-

transmitted "su'" call set-up request, the receiving MS(s) decides whether to join the call by receiving traffic communication direct from the master MS, or via the Repeater.

The Repeater can use either single frequency for "uplink" and "downlink" channels or a pair of frequencies. If a pair of frequencies are used, all receiving MS(s) will monitor both frequencies at a sufficient rate such that they can correctly decode both a call set-up request from a master MS and the Repeater's re-transmitted call set-up request. This is particularly advantageous if only one of the master MS or Repeater is within its communication range.

If the master MS call set-up transmission can be received and decoded properly, a receiving MS may have to tune their frequency synthesizer to receive the Repeater re-transmission signals in order to perform both link measurements.

The invention is described with reference to the TETRA DMO Repeater standard, although it is within the contemplation of the invention that the inventive concepts described herein apply to any fixed, wireless or wireless DMO communication system.

It is also within the contemplation of the invention that any number of alternative timing configurations would benefit from the inventive concepts described herein.

Turning now to FIG. 3, a block diagram of a MS 300, adapted to support the inventive concepts of the preferred embodiments of the present invention, is shown. The MS 300 contains an antenna 302 preferably coupled to a duplex filter or circulator 304 that provides isolation between receive and transmit chains within the MS 300.

The receiver chain includes scanning receiver front-end circuitry 306 (effectively providing reception, filtering and intermediate or base-band frequency conversion). The scanning front-end circuit 306 is serially coupled to a signal processing function 308.

In accordance with a preferred embodiment of the invention, the receiver chain has been adapted to receive both call set-up request transmissions on the master-link transmitted by the calling MS, as well as the re-transmitted call set-up request transmissions from the Repeater on the slave-link.

The scanning front-end receiver 306 has been adapted, in accordance with the present invention, to scan the appropriate frequencies and if necessary, say for paired frequency operation, switch between frequencies to decode signals transmitted on both a master-link and a slave-link.

The controller 314 may calculate receive bit-error-rate (BER) or frame-error-rate (FER) or similar link-quality measure data from recovered information via a received

signal strength indication (RSSI) 312 function. The RSSI 312 function is operably coupled to the scanning front-end circuit 306. The memory device 316 stores a wide array of MS-specific data, such as decoding/encoding functions and the like, as well as link quality measurement information to enable an optimal communication link to be selected.

A timer 318 is operably coupled to the controller 314 to control the timing of operations, namely the transmission or reception of time-dependent signals, within the MS 300. In the context of the preferred embodiment of the present invention, timer 318 will be used to synchronize the receiving MS to the timing initiated by the calling MS.

Furthermore, once the timing format has been initiated, the timer 318 is used by the controller to select the appropriate master-link and slave-link channels and time-slots for tuning to.

As known in the art, an output from the signal processing function is typically provided to a suitable output device 310, such as a speaker or visual display unit (VDU).

As regards the transmit chain, this essentially includes an input device 120, such as a microphone, coupled in series through transmitter/modulation circuitry 122 and a power amplifier 124. The transmitter/modulation circuitry 122 and the power amplifier 124 are

operationally responsive to the controller, with an output from the power amplifier coupled to the duplex filter or circulator 104, as known in the art.

Of course, the various components within the MS 300 can be realised in discrete or integrated component form, with an ultimate structure therefore being merely an arbitrary selection.

In operation, upon power-on of MS 300, the MS 300 will search (scan) for all call set-up requests where it may be addressed. Once an appropriate call set-up request has been received, from a calling MS setting up the master-link, the MS 300 will perform a signal quality measurement. The MS 300 will then switch to the slave-link to perform a similar signal quality measurement on the Repeater's re-transmitted call set-up request.

The signal processor function 308 will then determine which communication link will best suit the particular MS, and inform the controller 314 of the fact. The controller 314 will then organize the operation of the MS 300 such that an acceptable communication link to the calling MS is established.

Turning now to FIG. 4, a flowchart of the decision making process for a call set-up is shown, in accordance with a preferred embodiment of the invention.

The method includes the steps of a MS monitoring any appropriate frequencies searching for a call set-up

request, as shown in step 400. Once a call set-up request has been detected and decoded, as in step 402, the MS determines the type of call, as shown in step 404.

If the call-type is a master transmit call, without a repeater address, the MS determines that a regular DMO call procedure will be followed, as shown in step 408. If the call-type is a Repeater's re-transmission of a call set-up request on a slave-link, the MS determines that a regular DMO call via a Repeater procedure will be followed, as shown in step 406. In this case, it is likely that the receiving MS has not heard the calling MS's call set-up request, and is therefore only able to join the call via the Repeater.

If the call-type is not one of the above call-types, the MS performs at least one signal quality measurement on the master link, as in step 410. The MS then switches to the slave link, if appropriate, and waits for the Repeater's re-transmitted call set-up request transmission, as in step 412. The MS then performs at least one signal quality measurement on the Repeater's re-transmitted call set-up request transmission, as shown in step 414.

The two link quality measurements are then compared, as shown in step 416. If the master-link is determined to be of a better quality than the slave-link, the MS joins the DMO call by tuning into the master-link, as in step 420. If the slave-link is determined to be of a better

quality than the master-link, the MS joins the DMO call by tuning into the slave-link, as in step 418.

It is within the contemplation of the invention that the re-transmission of the call set-up request from the repeater may encompass any transmission from the repeater that indicates a request has been made.

In this manner, the MS has selected its optimal method of communicating in the call, without being constrained to purely receiving a Repeater's relayed transmissions.

It is within the contemplation of the invention that a receiving MS may not need to perform a signal quality measurement on the master-link, if it knows that it is out of range of the Repeater station. In such a situation, the only option to join a subsequent call is via a direct communication with the calling MS and, as such, no signal quality measurement needs to be performed.

It will be understood that the wireless communication system, wireless communication unit and method of call set-up described above provide at least the following advantages:

(i) The receiving MS(s) decide on the mechanism to join a call, via a repeater or by receiving signals directly from the master MS signal, based on measurements of the respective link qualities.

(ii) A MS is able to join a communication in scenarios where the Repeater would not ordinarily facilitate a communication to the MS, for example where the MS is outside the Repeater coverage, or in the case where a Repeater re-transmission will have a poorer quality than a direct MS communication.

(iii) The delay (call set-up and voice delay) introduced when setting up a direct communication link is less than the overall delay when operating through the repeater.

Thus a communication system, a communication unit and method of setting up a call have been provided where the disadvantages described with reference to prior art arrangements have been substantially alleviated.

Claims

1. A communication system comprising a plurality of communication units that communicate either directly or via an intermediary communicating unit, the communication system characterised by at least a first communication unit of the plurality of communicating units receiving directly a call set-up request from at least a second communication unit of the plurality of communicating units, wherein the call set-up request includes an indication that the call is to be set-up via the intermediary communication unit, and said first communication unit includes a signal processor for determining that a signal quality of the received call set-up request is or will be better than a signal quality of a re-transmitted call set-up request from the intermediary communication unit, and in response to such a determination the first communication unit participates in the call with the second communication unit directly.

2. The communication system according to claim 1, wherein said first communication unit includes signal quality determination means operably coupled to the signal processor for measuring a signal quality of the call set-up request transmitted by the second communication unit in order to determine that a call quality when participating in the call directly with the second communication unit is or will be acceptable.

3. The communication system according to claim 1 or claim 2, further characterised by the first communication unit comprising: monitoring means operably coupled to the signal processor, for monitoring both a communication link of the call set-up request and a communication link of a re-transmitted call set-up request as transmitted by the intermediary communication unit, the monitoring means being operably coupled to said signal quality measuring means for measuring a signal quality of the call setup request and a signal quality of the re-transmitted call set-up request and comparison means operably coupled to the measuring means for comparing the respective measured signal qualities and in response to the comparison determining whether to participate in the call directly with the second communication unit or via the intermediary communication unit.

4.The communication system according to claim 3, wherein the signal quality measurement includes any of the following: received signal strength indication, bit-error-rate, message-error-rate, carrier to interference, or other known indicia.

5. The communication system according to any one of the preceding claims, wherein the communication system is a direct mode radio communication system, the plurality of communication units are radio units capable of direct mode communication and the intermediary communication unit is a radio communication repeater.

6. A communication unit capable of communicating with a second communication unit either directly or via an intermediary communication unit, the communication unit characterised by:

a receiver for receiving directly a call set-up request from the second communication unit, wherein the call set-up request includes an indication that the call is to be set-up via the intermediary communication unit,

a signal processor operably coupled to the receiver for determining that a signal quality of the received call set-up request is or will be better than a signal quality of a re-transmitted call set-up request from the intermediary communication unit, and in response to such a determination the first communication unit participates in the call with the second communication unit directly.

7. The communication unit according to claim 6, further characterised by:

signal quality determination means, operably coupled to the signal processor, for measuring a signal quality of the call set-up request transmitted by the second communication unit in order to determine that a call quality when participating in the call directly with the second communication unit is or will be acceptable.

8. The communication unit according to claim 7, further characterised by:

monitoring means operably coupled to the signal processor, and the signal quality measuring means, for monitoring both a communication link of the call setup request and a communication link of a re-transmitted call set-up request as transmitted by the intermediary communication unit, the signal quality measuring means measuring a signal quality of the call setup request and re-transmitted call set-up request, and

comparison means operably coupled to the measuring means for comparing the measured signal qualities and in response to the comparison the signal processor determines whether to participate in the call directly with the second communication unit or via the intermediary communication unit.

9.The communication unit according to claim 8, wherein the signal quality measurement means measures any of the following: received signal strength indication, bit-error-rate, message-error-rate, carrier to interference, or other known indicia.

10. The communication unit according to any one of claims 5 to 9, wherein the communication unit is a wireless communication unit capable of operating in a direct mode radio communication system.

11. A method of setting up a call between a calling party and at least one receiving party, the method characterised by the steps of:

receiving a call setup request transmission from a calling party, wherein the call set-up request includes an indication that the call is to be set-up via an intermediary party; and

determining that a signal quality of the call set-up request is or will be better than a signal quality of a re-transmitted call set-up request from the intermediary party; and

participating in the call with the calling party directly.

12 The method of setting up a call according to claim 11, the method further characterised by the step of:

measuring a signal quality of the call set-up request transmitted by the calling party in order to determine that a call quality when participating in the call directly with the calling party is acceptable.

13 The method of setting up a call according to claim 12, the method further characterised by the step of:

monitoring, by the receiving party, of both a communication link of the call setup request and a communication link of a re-transmitted call set-up request as transmitted by the intermediary party;

measuring a signal quality of the re-transmitted call set-up request re-transmitted by the intermediary party; and

comparing the measured signal quality of a call set-up request transmitted by the calling party to the measured signal quality of the re-transmitted call set-up request in order to determine whether to participate in the call directly with the calling party or via the intermediary party.

14 The method of setting up a call according to any one of claims 11 to 13, wherein the calling party is a direct mode radio communication unit and the intermediary party is a radio communication repeater.

15 The method of setting up a call according to any one of claims 11 to 14, wherein the direct communication link is an up-link radio communication link and the communication link via an intermediary is a down-link radio communication link.

16. A wireless communication system, substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 1 of the accompanying drawings.

17. A wireless communication unit substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 3 of the accompanying drawings.

18. A method of setting up a call substantially as hereinbefore described with reference to, and/or as illustrated by, FIG. 4 of the accompanying drawings.

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Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

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Other: WPI, EDOC, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage	Relevant to claims
A	GB 2325379 A (SONY)	
A	GB 2320161 A (MOTOROLA)	

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
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